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AUTHORITY	
USNSWC ltr, 24 Jun 1976; USNSWC ltr, 24 Jun 1976	

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U S NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

REPORT NO 1140

TESTING OF WARHEADS FOR  
AIR TARGET GUIDED MISSILES

63rd Partial Report

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FRAGMENTATION TESTING OF  
DUAL INITIATED 3\*5 WARHEAD NO 144

FINAL Report

Task

Assignment MPG-Re3f-607-1-53

Copy No. 11

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MPG REPORT NO. 1140

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NPG REPORT NO. 1140

Fragmentation Testing of Dual Initiated 3"5 Warhead No. 144  
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PART A

SYNOPSIS

1. This test was conducted to determine the fragment velocity distribution and space distribution of 3"50 Warhead No. 144 loaded with Composition C-3 and initiated at two points simultaneously. The explosive charge was an annulus 0"60 thick, 2"88 O.D., and 12"0 long. Both initiators were at one end of the warhead and diametrically opposed.
2. The 3"50 Warhead No. 144 with an 0"6 annulus of Composition C-3 shows no appreciable increase of fragment velocity with increased distance from the initiators. Neither is there any noticable change in fragment space distribution of fragments with respect to the axis through the initiators.

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NPG REPORT NO. 1140

Fragmentation Testing of Dual Initiated 345 Warhead No. 144  
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Fragmentation Testing of Dual Initiated 345 Warhead No. 144  
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PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3f. 507-1-53, reference (b).

2. REFERENCES:

- a. NOL Conf work request WG/29/53 of 16 December 1952
- b. BUORD Conf ltr NP9-Re3f-RKJ:gg Ser 42699 of 29 July 1952
- c. NPG Conf Report No. 866 of 27 October 1951

3. BACKGROUND:

Reference (b) authorized the Naval Proving Ground to work directly with the Naval Ordnance Laboratory in the development and testing of warheads for guided missiles. It was desired to determine the effect of dual initiation on fragment velocities in a small scale warhead. To this end, three 345 Warheads No. 144 were designed.

4. OBJECT OF TEST:

This test was conducted to determine the fragment velocity distribution and space distribution of 345 Warhead No. 144 loaded with Composition C-3 and initiated at two points simultaneously. The explosive charge was an annulus 0460 thick, 2488 O.D., and 1240 long. Both initiators were at one end of the warhead and diametrically opposed.

5. PERIOD OF TEST:

- |   |                  |
|---|------------------|
| a. Date Project Letter                  | 16 December 1952 |
| b. Date all Necessary Material Received | 17 December 1952 |
| c. Date Commenced Test                  | 1 April 1953     |
| d. Date Completed Test                  | 1 April 1953     |

6. REPRESENTATIVES PRESENT:

This test was witnessed by Messrs. L. E. Hightower, A. Popernack, and S. Wolf representing the Naval Ordnance Laboratory.

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Fragmentation Testing of Dual Initiated 375 Warhead No. 144  
-----PART CDETAILS OF TEST

## 7. DESCRIPTION OF ITEM UNDER TEST:

a. Warhead No. 144, as shown in Figure 1, consisted of two concentric cylinders, 12" long. The inner cylinder was welded to a 1/8" steel end plate, and this assembly screwed to the outer cylinder with 4 screws. The 0760 thick annular space between the cylinders was loaded with Composition C-3 explosive.

b. The initiating train for this warhead (Figure 2) was held in place by a small bakelite rod inserted in a fiber plug which was cut to fit inside the open end of the inner cylinder. Taped to the rod were two primacord leads going from an engineers' special blasting cap to two 1/2" diameter tetryl boosters placed in the open end of the annulus diametrically opposite each other.

## 8. PROCEDURE:

Each of the three warheads was placed on a platform 6.5 feet high with the closed end down and the detonation train up, at the center of a 30' radius velocity arena. The arena panels consisted of 1" thick STS armor plate 15 feet high in longitudes 123° to 183° and 350° to 50°. The line through the boosters was oriented to 50° and 230°. The panels were marked off in 5° zones and fragment hits were recorded by a 16mm Fastax camera at about 4400 frames/sec. The hits were grouped into two sections: (1) the "In Line" section which includes hits within 45° of the line through the boosters and (2) the "Abeam" section which includes all hits not within 45° of line through the boosters. The "in line" section includes all hits on plates from 5° to 50° and the "abeam" section includes hits on plates from 350° to 5° and from 125° to 180°. A sketch of the arena is shown in Figure 3.

Fragmentation Testing of Dual Initiated 345 Warhead No. 144  
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## 9. RESULTS AND DISCUSSION:

a. The velocity of fragments in the "abeam" section was slightly higher than the velocity in the "in line" section, but the difference was so slight that there is no real indication of velocity change with direction, within the accuracy of this test. The velocity results are tabulated in Tables I, II, and III.

b. The incidence of effective fragments striking the "in line" section and those striking the "abeam" section was the same within the experimental error of the test. The ratio of "in line" hits incidence to "abeam" hits incidence was 1.04 overall. It must be noted that the term "effective fragments" refers to fragments that were estimated to be able to penetrate 1/8" mild steel plate. These results are tabulated in Table IV.

c. Thus, on a small scale no measurable change in fragment velocity or space distribution was observed with respect to orientation of the two boosters. On a larger scale (24" diameter warheads with greater distances between the boosters) a velocity differential was noted, reference (c).

PART DCONCLUSIONS

10. The 3450 Warhead No. 144 with an O76 annulus of Composition C-3 shows no appreciable increase in fragment velocity with increased distance from the initiators. Neither is there any noticeable change in fragment space distribution of fragments with respect to the axis through the initiators.

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Fragmentation Testing of Dual Initiated 3V5 Warhead No. 144  
-----

The tests upon which this report is based were conducted by:

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Fragmentation Division  
Terminal Ballistics Department

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Fragmentation Division  
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Captain, USN  
Commander, Naval Proving Ground



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Captain, USN  
Ordnance Officer  
By direction

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U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Sixty-third Partial Report

on

Testing of Warheads for Air Target Guided Missiles

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Final Report

on

Fragmentation Testing of Dual Initiated 385 Warhead No. 144

Project No.: NPG-Re3f-607-1-53  
Copy No.: 11  
No. of Pages: 6

Date: JUN 16 1953

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# A

DIAMETRAL MARKS TO  
ALIGN BOOSTERS.

SECTION A-A

NOTE:  
TAPE PRIMA-CORD LEADS  
TO FIBER ROD

DETONATOR (ENGINEER'S SPECIAL)

PRIMA-CORD (AP-1A)

BOOSTER (TETRYL)

WARHEAD 144  
OR 1240862

EXPLOSIVE  
(COMB-C)

FIBER PLUG

FIBER ROD

REVISIONS OF THIS DRAWING  
BY DATE  
1. 1240862 1240862 1240862

DESIGNED BY  
U. S. A.  
NAVY AIRCRAFT LABORATORY  
11-1000-1000-1000

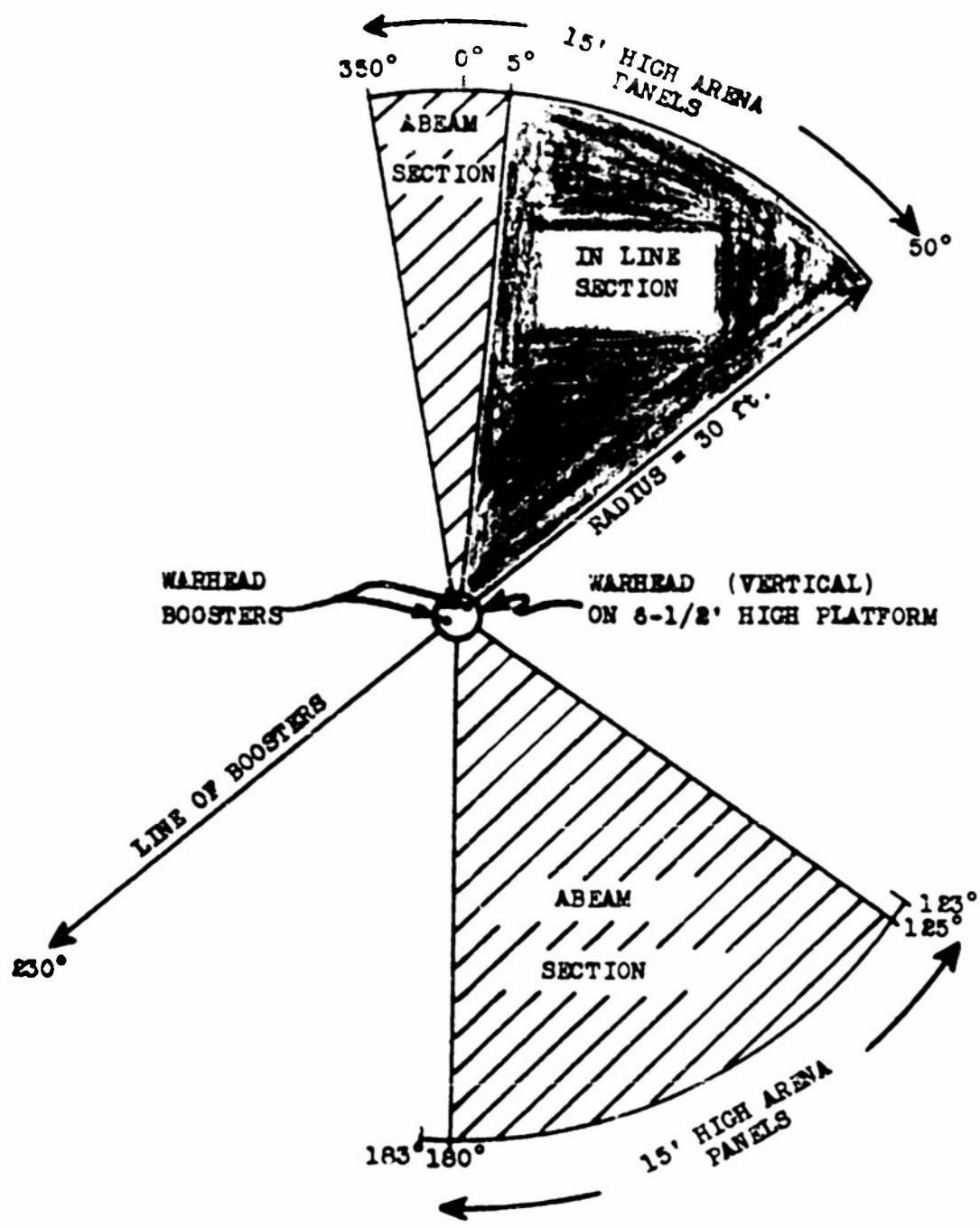
1240876

DETONATION TRAIN  
WARHEAD 144

1/1

REVISIONS	DATE	BY	REASON
1	1240862	1240862	1240862
2	1240862	1240862	1240862
3	1240862	1240862	1240862
4	1240862	1240862	1240862
5	1240862	1240862	1240862
6	1240862	1240862	1240862
7	1240862	1240862	1240862
8	1240862	1240862	1240862
9	1240862	1240862	1240862
10	1240862	1240862	1240862
11	1240862	1240862	1240862
12	1240862	1240862	1240862
13	1240862	1240862	1240862
14	1240862	1240862	1240862
15	1240862	1240862	1240862
16	1240862	1240862	1240862
17	1240862	1240862	1240862
18	1240862	1240862	1240862
19	1240862	1240862	1240862
20	1240862	1240862	1240862

USED ON  
APPLICATION



TOP VIEW OF 30' ARENA

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FIGURE 3

APPENDIX A

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Fragmentation Testing of Dual Initiated 375 Warhead No. 144

TABLE I

FRAGMENT VELOCITY DATA

30' Radius Velocity Arena  
16mm Camera  
Rd. 1, 375 Warhead No. 144-1  
Total Weight 15.73 lbs.

4300 Frames per sec.  
Comp. C-3  
Date: 1 April 1953

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	<u>In-Line Section 5°-50° No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
35	30-35	1	1	3690
36	20-25 40-45	1 1	2	3580
37	45-50	1	1	3490
38	20-25 40-45	1 1	2	3390
39	25-30	1	1	3310
40	25-30	1	1	3230
41	20-25 35-40	1 1	2	3150
43	5-10	1	1	3000
47	25-30	1	1	2740
Median				3380
Average				3310

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## Fragmentation Testing of Dual Initiated 3W5 Warhead No. 144

TABLE I (Continued)

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	Abeam Section 350°-5° 125°-180° <u>No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
35	175-180	1	1	3690
36	350-355	1		
	0-5	1		
	125-130	1		
	130-135	1		
	155-160	2		
	160-165	1		
	165-170	1		
	175-180	2	10	3580
37	0-5	1		
	125-130	1		
	150-155	1		
	155-160	1		
	160-165	1		
	170-175	1	6	3490
38	350-355	1		
	155-160	1	2	3390
39	165-170	1	1	3310
40	350-355	1	1	3230
41	175-180	1	1	3150
Median				3550
Average				3500

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Fragmentation Testing of Dual Initiated 3V5 Warhead No. 144

TABLE II

FRAGMENT VELOCITY DATA

30' Radius Velocity Arena  
16mm Camera  
Rd. 2, 3V5 Warhead No. 144-2  
Total Weight 16.24 lbs.

4400 Frames per sec.  
Comp. C-3  
Date: 1 April 1953

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	<u>In-Line Section 5°-50° No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
37	45-50	1	2	3570
	25-30	1		
38	5-10	1	2	3470
	25-30	1		
39	5-10	2	5	3380
	10-15	1		
	20-25	1		
	35-40	1		
40	5-10	1	1	3300
41	5-10	1	4	3220
	20-25	1		
	25-30	1		
	45-50	1		
45	35-40	2	2	2930
46	25-30	1	1	2870
48	10-15	1	1	2750
Median				3350
Average				3260

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## Fragmentation Testing of Dual Initiated 345 Warhead No. 144

TABLE II (Continued)

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	<u>Abeam Section 350°-5° 125°-180° No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
36	170-175	1	2	3670
	175-180	1		
37	145-150	1	4	3570
	155-160	1		
	165-170	1		
	175-180	1		
38	350-355	1	5	3470
	135-140	1		
	140-145	1		
	160-165	1		
	165-170	1		
39	125-130	2	5	3380
	150-155	1		
	0-5	2		
40	0-5	1	4	3300
	125-130	1		
	165-170	1		
	170-175	1		
41	350-355	1	2	3220
	165-170	1		
42	0-5	1	2	3140
	130-135	1		
43	350-355	1	1	3070
45	0-5	1	1	2930
Median				3440
Average				3380



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Fragmentation Testing of Dual Initiated 345 Warhead No. 144

TABLE III

FRAGMENT VELOCITY DATA

30' Radius Velocity Arena  
16mm Camera  
Rd. 3, 345 Warhead No. 144-3  
Total Weight 16.24 lbs.

4450 Frames per sec.  
Comp. C-3  
Date: 1 April 1953

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	<u>In-Line Section 5°-50° No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
36	40-45	1	1	3710
38	5-10	1		
	20-25	1		
	30-35	1		
	40-45	2		
	45-50	1	6	3510
40	25-30	1		
	30-35	1		
	35-40	1	3	3340
41	15-20	1		
	25-30	1		
	30-35	1		
	40-45	1	4	3260
42	15-20	1		
	25-30	1		
	35-40	1	3	3180
43	10-15	1		
	45-50	1	2	3100
45	10-15	1	1	2970
46	30-35	1	1	2900
47	40-45	1	1	2840
Median				3350
Average				3290

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Fragmentation Testing of Dual Initiated 345 Warhead No. 144

TABLE III (Continued)

<u>Frame in Which Hit Occurred</u>	<u>Zone</u>	<u>Abeam Section 350°-5° 125°-180° No. Fragments</u>	<u>Total Hits</u>	<u>Velocity (f/s)</u>
37	175-180	1	2	3610
	350-355	1		
38	140-145	1	3	3510
	155-160	1		
	0-5	1		
39	350-355	1	4	3420
	0-5	1		
	130-135	1		
	160-165	1		
40	125-130	1	2	3340
	160-165	1		
41	140-145	1	7	3260
	150-155	1		
	155-160	1		
	160-165	2		
	165-170	1		
	170-175	1		
42	125-130	1	4	3180
	150-155	1		
	175-180	2		
44	125-130	1	3	3030
	135-140	1		
	155-160	1		
45	160-165	1	1	2970
Median				3330
Average				3300

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## Fragmentation Testing of Dual Initiated 375 Warhead No. 144

TABLE IVSPACE DISTRIBUTION DATANo Hits Capable of Penetrating 1/8" Mild Steel Panels

30' Radius Velocity Arena  
 1" STS panels 15' high

<u>Longitude</u> <u>Zone</u>	<u>Rd. 1</u> <u>144-1</u>	<u>Rd. 2</u> <u>144-2</u>	<u>Rd. 3</u> <u>144-3</u>		<u>Totals</u>	<u>Average</u>
350-355	3	5	5 )	Abeam	13	4.3
355-0	1	2	2 )		5	1.7
0-5	3	5	5 )		13	4.3
5-10	2	4	3 )	In Line	9	3.0
10-15	4	5	3 )		12	4.0
15-20	1	4	3 )		8	2.7
20-25	3	2	5 )		10	3.3
25-30	5	4	5 )		14	4.7
30-35	1	5	7 )		13	4.3
35-40	2	3	2 )		7	2.3
40-45	2		5 )		7	2.3
45-50	1	5	3 )		9	3.0
125-130	5	4	4 )	Abeam	13	4.3
130-135	4	2	2 )		8	2.7
135-140	3	2	3 )		8	2.7
140-145	2	5	5 )		12	4.0
145-150	1	3	2 )		6	2.0
150-155	4	5	2 )		11	3.7
155-160	1	4	4 )		9	3.0
160-165	1	3	4 )		8	2.7
165-170	5	3	2 )		10	3.3
170-175	5	2	3 )		10	3.3
175-180	3	4	2 )		9	3.0

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APPENDIX C

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Fragmentation Testing of Dual Initiated 3W5 Warhead No. 144

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